

22.0 FLIGHT EQUIPMENT

22.1 CSM

CERNAN The event timers and controls worked excellently. There were no anomalies, no problems.

SHEPARD Did you have an LEB timer?

CERNAN The LEB timer worked fine the whole flight. During launch, somehow the mission event timer on the main display panel got off. We reset it and it was fine throughout the mission. I don't know what happened during launch to cause that. We never received an explanation.

SCHMITT That's good recollection. You're right.

CERNAN Crew compartment configuration - As far as I'm concerned that is stowage and it was exactly as advertised. We had a few bags that blew up. Once we opened the compartments we couldn't get them back in. I had to stab holes in them, They happened to be the OPKs. I had to take my scissors and punch a hole in seven or eight of the OPKs in order to restall them. When Ron opened the compartment they just went, "plonk." Every one of them blew up. I took the scissors and went klonk, klonk, klonk, to let the air out. The only problem we had on stowage was the OPKs. The mirrors worked fine. The IV clothing and

**CONFIDENTIAL**

CERNAN related equipment worked fine. If Jack and I had one request, (CONT'D) it would be to carry one more CWG for cleanliness. Particularly when you come back from the LM as dirty as you are, we could have used one more CWG throughout the entire flight. We had no problems with the IV pressure garments and connecting equipment. Ron may want to mention the g-suit.

EVANS The g-suit was a looser fit than it was when I took off which surprised me. I thought my legs would be fatter.

CERNAN The couches - We got the center couch out and in with no problems. We got the YY struts connected and disconnected many times with no problems. The restraints worked fine. The inflight tool set was really never used except for tool B for the hatch work and tool E for all the continued panel work.

EVANS The ones we used were good.

CERNAN There are a lot of data collection systems. Every one of them that we used, whether it be pen and pencil in the Flight Plan or the DSE, appeared to be working nominal.

Thermal control of the spacecraft - Because of the lack of the PTC control on the way home due to the UV and the IR requirements, the spacecraft was in attitudes where I think it got very cold at times.

**CONFIDENTIAL**

~~CONFIDENTIAL~~

22-3

EVANS It got cold and damp on the inside.

CERNAN We transferred water from the overhead hatch to the forward hatch and the forward hatch started perspiring. We warmed the spacecraft up by manual setting of the temperature control inlet valve and putting the number 3 inverter on the line. It became very comfortable and we were that way for about 36 hours. Then went back to normal for the entry.

EVANS Camera equipment was nominal. Everything worked real fine. I haven't seen any pictures yet.

SIM bay equipment - The only problem we had was extension and retraction of HF antennas. In all cases, we ended up eventually getting them fully extended and fully retracted. We never did get the retract barber pole on HF 1 throughout the flight. The ground was watching the motor currents and were able to tell when it was retracted. The ground never did get the barber pole indication either on the full retract of HF 1.

SCHMITT I heard Gene say it took 2 or 3 days to get squared away on how to take care of yourself and your personal items. I didn't think it took that long, I think about a day is what you require. I think you should not completely program the first 2 or 3 days.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~SCHMITT  
(CONT'D)

You ought to build up to a full flight schedule, for example on Skylab, over the first few days because of the variability in adaptation to the new environment. I think that organizing your own personal items does not take more than a day to really get into the swing of things. I tended not to wear the coveralls the first few days of flight. The first couple days or so I just wore the constant wear garment, but I gradually got in to where I wore the trousers and that was partly to have available the the pockets for odds and ends like PRDs. I felt no thermal discomfort just wearing the CWG until transearth coast when it got much cooler because of the variable PTC attitudes.

The lightweight headsets, I did not use very much until the last couple days of the flight, but when I used them they seem to be perfectly adequate. Ron has probably talked about the problem he had with the headset which I subsequently ended up using only as a cover for my head and used the lightweight comm carrier attached to it.

Medical data seem to go fairly well; it was just a matter of keeping up to date. I did most of it on the translunar leg and Ron did most of it on the transearth leg. It varies whether we use negative reporting on food or positive reporting. It depends on what we've eaten and how much we've eaten.

~~CONFIDENTIAL~~

SCHMITT  
(CONT'D)

Camera equipment, to our knowledge, in flight functioned very well. We understand that we may have had one jammed magazine EE, but at least it transported film for at least half a mag. At the window where most photography is being done, it's useful to have a camera configured for the anticipated type of photography that you would want. Lens configuration, f-stop, and shutter speeds - For the most part we kept the dark slide out of the camera for rapid access to pictures. That was in both transearth and translunar orbit operations.

The kitchen timer, the interval timer I guess it's called, was a very useful item. I had the feeling that it needed a little better time calibration on it. But in using it for the SIM bay operation, sometime you would like to have a little more accurate timing. There's also, I think, usefulness in certain places in the spacecraft to have hook Velcro as well as pile, because hook is useful for hanging up washcloths and other items that in themselves represent a pile configuration. We made considerable use of of the spring bungees stretched across the switch panels in order to not only control the data books that we're using but also to aid in biomed donning by putting all the gear in one spot with the bungee. Also, it was used during eating and to hold the various food packs. We tended to put the food Velcro next to the flight Velcro because it was of a superior quality.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~SCHMITT  
(CONT'D)

The gray tape in the CSM is really useful only when you stick it to itself. It does not stick to spacecraft or anything else very well. We tended to save the food pack tape which is much better gray tape than the stowed tape.

We had an adequate amount of tissue, but I think had we had any more problem than we did with the loose bowel movements that we would have run out of tissue. I think you ought to consider that if there's any concern that we may not solve our problems of loose bowel movements that, in Skylab, there should be some way to stow a considerable amount of extra tissue. I think we had just the right amount of towels. It gave us the option of cleaning up at times and not being concerned about using dirty towels several times.

## 22.2 LM

CERNAN

Crew compartment configuration on the LM was as the mockup configuration and as advertised. There were no problems, throughout storage or unstorage. Restraint systems were used for descent and ascent. They worked fine. We used no tools in the LM that I can recall. Our camera equipment had only one anomaly that I know of. A 16-millimeter camera failed to start during ascent. The LMP tried to start the camera in 12 frames per second. He couldn't start it. He had to hold it and it would

~~CONFIDENTIAL~~

CERNAN  
(CONT'D)

run in 24 frames per second. He'll have to describe the details. It did run by itself 12 frames per second later. So we might have to go back and make a check and pick up with Jack on that camera.

SCHMITT The LM crew compartments was fine. We had no trouble except in one incidental case in finding the gear. The restraint system I used during descent and ascent worked fine. We had all the tools that we needed; of course, we didn't need any to speak of. We got by with one pair of scissors both for the cabin and surface operation for the obvious reasons that one had disappeared in the command module.

Again the same comment is that in the LM the gray tape was not adequate.

Camera equipment in the LM was more than adequate. We brought back the CDR surface camera and that was used during the rendezvous for air-to-air pictures and also for air-to-ground pictures and it was used for LM magazines in the command module until we had used up all the LM film that had not been used on the surface for lunar orbit operations. Only half a mag of black and white film was available for use during the post-rendezvous period. I think we used just about every frame of

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~SCHMITT  
(CONT'D)

film that was reasonably available to us in the flight. We used all the IM film but maybe half a mag of black and white and half a mag of color prior to lift-off. By the end of the rendezvous sequence, we had used up all the color; and then by the end of our TEI, we used up the rest of the black and white for target-of-opportunity pictures. I think it's a serious mistake not to do everything possible to stow more film than you need. We had just the right amount of film. We were conservative about, film usage but not generally conservative. We took all the pictures we wanted. The crew just shouldn't be reluctant to take pictures because that's the prime mode of documentation.

~~CONFIDENTIAL~~

23.0 FLIGHT DATA FILE

CERNAN The Flight Data File was in tune with the flight; it was complete; it was followed; and it was in excellent shape.

EVANS It was in outstanding shape. There was absolutely nothing wrong with it.

CERNAN We had minimal updates to the crew cue cards and minimal updates to the Flight Plan. Flight planning did a super job getting it all together. There's nothing we can add to it. The Lunar Surface Checklist was the one that had most real-time updates and that was simply based on mileages and bearings because the LM position was slightly east of where we had set up the Lunar Surface Checklist. The Checklist was changed in real time because of the time allotted at each station. That's to be expected as the checklist is only a guideline anyway.

23.1 CSM

SCHMITT Generally, I have nothing but praise for the Flight Data File, both vehicles. One comment on the Flight Plan Supplement. We had split pages for medical and food logging. That was probably a mistake. We tended to only use the book as a whole and it was a good place to keep them. If you had wanted the pages split they were too thin to maintain. Furthermore, they tended to fall out of the book, I recommend not splitting the pages

~~CONFIDENTIAL~~SCHMITT  
(CONT'D)

or having heavier paper if you want them split. I had an extra cue card built for panel 229. I think it was an excellent card that summarized the circuit breaker functions both on 229 and on panel 8. It was not used because we had no systems anomalies of any significance that would relate to that card. But I would strongly recommend its availability if only for training. It's a good quick review of what you lose or retain for those two panels.

In the Flight Plan, I added some pen and ink cues along the margins for certain observational targets that I particularly wanted to look at. These are independent of any designated experiment and I entered them as a function of time. That seemed to work very well for me. I think it is the easiest way to go, since it shouldn't concern any large number of people. Gordy Fullerton fixed up the circular orbital cue card for me with similar designation of craters as a function of time. I did not use that. Not because it wasn't a good idea but because of familiarity with the Moon, which came very quickly after a couple of orbits. You could recognize your position on the Moon fairly easily as a function of each rev, either timing the rev, approximate time since sunset, or just because you could look out the window and could tell where you were.

~~CONFIDENTIAL~~

23.2 LM

SCHMITT The same comments apply. I think all the Flight Data File items were excellent. We logged most of our specific items such as alinement data and comparable kinds of things in the checklist and at the point where they were collected rather than in the Data Book.

Cuff checklist - We talked about that in the surface items. I thought the cuff checklist was excellent.

We had the right kind of photo maps and they were useful for reference when we were around a given station. I don't think we used them as much as I had anticipated.

Navigation was no problem as the points that we had selected previously were excellent points for investigation. There was no need to try to decide on an alternative point to try to study in the vicinity of a given station. The list of items to be accomplished at each station were mindjoggers to read at each station. They were not used as much as I thought they would be initially. That was mainly because we had become so familiar with the items that each station was in itself easy to recall as a result of having created the checklist. So, the checklist was turned out to be more of a learning item rather

~~CONFIDENTIAL~~

SCHMITT than a reference item for use on the surface. I wouldn't  
(CONT'D) have done it any differently.

I particularly want to compliment Chuck Lewis on the Timeline Book. The book was very very well done and we had no problems with it at all. That of course applies to every checklist we had. There were no procedural errors in any of the books. Fortunately, we did not have to use the Malfunction Book. Only once did I pull out the Systems Data Book to check on a systems problem and I can't remember what that was now.

### 23.3 CHARIS AND MAPS

EVANS I never did use the sun compass. I didn't have time to get it squared away or to figure out where it was and follow it around. I never used it as much as I thought I was going to prior to the flight. After you've been up there for a while you could look out the window and tell essentially where you were, so you really didn't need it. You kind of guess pretty much on the settings for the cameras and hopefully there wasn't any problems in that respect. We used the orbit monitor charts. They are not as good as they could be but were useful in finding out where you were and looking up a few of the craters. I did not use the contingency chart at all.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

CERNAN Let me comment about the IM landing site monitor chart and ascent monitor chart. The only time we used these charts was in observing the landing site from the command module on a day prior to landing. Because of the operation of the PGNS and the ascent guidance systems we did not have to use the ascent monitor chart at **all**.

Lunar surface maps - We used in the cockpit after the EVAs but only pointedly toward trying to relocate our traverse and make sure we were aware of the craters we saw and where we had been. They were **sort** of a resume-type post-EVA rather than pre-EVA planning guide. Let Jack comment on the EVA traverse maps. I think we used them far **less** than Jack planned. I used my cuff checklist for all my navigation and for my traverse even though I was told that it would be relatively useless. My cuff checklist was a very vital part of my lunar surface navigation.

WARD ~~What~~ did you use to make the fender with?

CERNAN In that respect, they were very useful.

SCHMITT I thought I would use the orbit monitor charts in the CM, so I had an extra one put on so it wouldn't interfere with the planned activities of the CMP. I did not use that very much. I eventually did some sketching on it post-TEI. I think I labeled about five specific points as areas A, B, C, D,

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

SCHMITT  
(CONT'D) maybe E, and these are referenced in my crew notebook for a specific observations.

One item - that chart should have been identical to the CMP's chart. There were a few pen and ink changes left off such as exposure settings for certain photo targets that caused some confusion. The CSM lunar landmark maps that the LMP had added in the rear of that book, again, were not used. As I was observing a specific point or area such as Gagarin I would not take the time out to sketch on the photo. I tended to look at the first opportunity and to take notes in the notebook rather than trying to sketch on the photograph.

I think having selected them and studied them preflight made it worth having them around. The necessity for flying them was probably less than the necessity for having reviewed them and studied them. I still would want to have that kind of data available in the spacecraft. I think the CMP used his visual target maps considerably. I did on a couple of occasions. For the most part, that was post-TEI and I made some notes and sketches on some of those maps. I think that function was because there was a lot of time to look at the Moon make a sketch, and then look back and fix it up post-TEI. In orbit, the time just did not exist. As Dick Gordon said a couple years ago, "Once you start flying, the clock is relentless."

~~CONFIDENTIAL~~

23.4 GENERAL FLIGHT PLANNING

EVANS Outstanding.

CERNAN This may be an appropriate place to comment on how we handled the lunar orbit phase with three men in the spacecraft. After the first 2 hours in the spacecraft, we figured out the most expeditious and efficient way of handling it and it worked that way throughout the rest of the flight. The CDR got in the left seat, where he belongs anyway and took the Flight Plan. Windows 5, 4, and 3 point towards the lunar surface so I let the orbital geologist and the surface geologist look out the windows and make all their finds. I kept them honest on SIM bay, made all the attitude changes that were required, and kept them up to date on all SIM bay switch changes. I ran the spacecraft, they did the orbital geology, and I kept them honest. I kept out of their way. I stayed on my side of the spacecraft, kept the systems and the world honest and they cut loose. That's the way I'd recommend doing it all the time. You didn't bump into each other. Occasionally I would sneak a peek and say they were right or wrong and let it go at that.

EVANS Level of details provided in onboard documentation/recommendation changes - Solo phase - I have no recommended changes. It was in outstanding shape. We had gone through it before and checked it out in the simulator.

~~CONFIDENTIAL~~

CERNAN I want to comment under miscellaneous. I think the Flight Plan carried just enough detail to tell you what was going on and what was going to happen. If you were not familiar with the details of the operation of that particular system or what you were going to do in terms of going into PTC or any other phase in the mission it would refer you to the Systems Book or G&C Dictionary. You did not have to repeat them in the Flight Plan. I like this way of doing things. We generally had the Flight Plan plus two other documents out. One was a Systems Book and the other was probably a G&C Dictionary.

EVANS We kept the G&C dictionary out. In the solo phase, I had the Experiments Checklist out, too.

SCHMITT The Flight Plan was excellent. We had no problems with it at all that I'm aware of. Tommy Holloway and his people are to be complimented. The number of different requirements and experiments and general operational items that were required to be integrated was very very high. It was done in an extremely competent and usable way. I can't think of anything that I would change in the way that the Flight Plan was written.

### 23.5 PREFLIGHT SUPPORT

EVANS Good.

CERNAN Updated properly. This is both LM and CSM.

~~CONFIDENTIAL~~

EVANS      The CSM had no problem. We would give the information to the people at the Cape and they would make the changes in the CSM and quarters copies. We had them in a timely manner. Coordination was good between the Cape and Houston.

Change propulsion system - There were very few changes in the checklists themselves once you came out with the primary book. There were few changes after that.

Real time procedures changes - They were quite nominal and from the CSM standpoint easily taken care of.

CERNAN     As far as I'm concerned, the LM preflight support on the Flight Data File was excellent. If there's anyplace that I'd make a comment on it was the fact that somehow the latest changes we thought were in a system somehow never got in until the morning of the sim. They were always there for the sim.

Real-time procedural changes in the LM - There were really none except for the EVA. In the command module, they were so minimal that it was no problem updating the Flight Plan as we went along. I might add that the clock sync was so smooth that you wouldn't even believe that it. It went "zap," we updated our clocks, and we were on our way. That put us right on the Flight Plan and that's probably one of the smoothest ideas anyone ever had.

~~CONFIDENTIAL~~

SCHMITT    Excellent in the Flight Data File area.    One specific item that I had was two or three briefing sessions on portions of the lunar orbit during which I was in the CSM spacecraft.    We went over in detail the attitudes, maneuvers, and the window availabilities so that I was able to plan in a very short amount of time with minimum effort my part for *my* own personal observations of the lunar surface.    I appreciated that extra above and beyond the call of duty on the part of the flight planners.    I appreciated their taking time out to do that for me.    I think it was useful to have the sessions where the flight controllers, the crew, and the flight planners met and went over those portions of the Flight Plan which were not normally simulated.    I was a little bit disappointed in that some of the people who would be eventually intimately involved in the mission were not at the Flight Plan review.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

24.0 VISUAL SIGHTINGS

CERNAN Countdown - It was dark and we didn't see anything until S-IC ignition, The CDR and the CMP could see out their small windows in the BPC the glow of ignition prior to lift-off.

Powered flight - During the actual powered flight of the S-IC you could not see anything at all. You couldn't see out the cockpit, as we had the lights up fairly bright. At staging, the S-IC shut down, something that you don't see in the daylight is that the fireball overtook us.

EVANS It sure did.

CERNAN When the S-II lit off, we literally for a nanosecond flew through the bright yellow fireball that was left over from the S-IC. Tower jett was very evident. You could see the flash and I could see the entire BPC. I could see underneath it. It was lit up underneath. The whole thing was lit up. I could see nothing on S-II until S-II shutdown. I could see the glow of S-IVB ignition. I say the glow of S-IVB ignition, it very easily could have been the fireball of S-II which tried to overtake us but couldn't quite make it. But there was a glow right during the period of S-II shutdown to S-IVB ignition. During the S-IVB burn, you could see the glow of the aft engines throughout the burn and throughout the orbital

erret

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~CERNAN  
(CONT'D)

Earth orbit - I might comment that the availability of stars for a mode II or mode IV abort was pretty poor for two reasons. Number one: night adaptability because we had lights very bright. When we turned the lights down in the cockpit, I could not pick out distinct constellations such as Orion, which I was planning on using for a mode IV abort. If we would have had an SCS and G&N problem it would have been very difficult to pick out stars for that abort.

EVANS

I should mention in Earth orbit you couldn't see the stars in the telescope in the daylight but they showed up nice and bright and clear in the sextant. I think that is probably a typical thing.

CERNAN

When we burned out of Earth orbit, we started the burn in darkness and flew right on through a sunrise during the TLI burn. This was pretty spectacular. We shut down in daylight and had no other visual sightings at that point in time.

Translunar/transearch - After CSM separation from the booster and docking with the LM several hours later, we could see something which may have been the S-IVB or SLA panels. As soon as we turned around for docking I could see three of the four SLA panels tumbling slowly in space. This is not unusual. That's been seen before.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

24-3

EVANS I never did see a SLA panel.

CERNAN There seemed to be an awful lot of particles with us continually throughout the flight, both in transearth and translunar coast and in lunar orbit. These particles were obviously residue from the RCS. Others were **from** dumped residues. They seemed to be hanging around the LM as a result of pulling in and out of the S-IVB and they were always **small** particles. Some, initially, were pieces of Mylar from the S-IVB LM separation. The others were just like small dump crystals or residue. On the LM, particularly, when you fire the RCS you could see the RCS residue.

EVANS That residue from the RCS didn't look a lot different than a waste-water dump.

CERNAN That's right, except that it's less dense.

EVANS Entry - Just the fireball, and the fireball is a lot brighter than I thought it was going to be. I almost wish I would have had sunglasses. It was really bright out of the rendezvous window just shortly after the .05g when you start picking up the greatest portion of the fireball. That brightness only lasted for maybe 30 to 40 seconds. Then either you became accustomed to the brightness or the brightness decreased. From that point on, I could see the instrument panel. Long

~~CONFIDENTIAL~~

**CONFIDENTIAL**EVANS  
(CONT'D)

after the brightness of the fireball decreased, I could look back up through the rendezvous window and see what to me was kind of like a tunnel with a bright spot in the middle of the tunnel. Way down the tunnel, way back behind, I could see the fireball.

CERNAN

The only unusual sighting I can recall during landing or recovery is when the CMP looked out the window and saw the superstructure of an aircraft carrier and said, "Oh, we've got a tin can with us."

EVANS

Well, it was kind of foggy on the windows.

SCHMITT

Transearth we had only a small crescent of an Earth and it was not feasible to do any extensive weather observations. We had light flashes just about continuously during the whole flight when we were dark adapted. I had one which I thought was a flash on the lunar surface. That one period of time when we had the blindfolds on for the ALFMED experiment there were just no visible flashes, although that evening, that night, before I went to sleep I noticed that I was seeing the light flashes again. So, it just seemed to be that one interval either side of it where the light flash was not visible to myself or to the other two crewmen.

**CONFIDENTIAL**

~~CONFIDENTIAL~~

25.0 PREMISSIONPLANNING

CERNAN Mission plan - A lot of work went into the mission plan, with the right people. I think we came out with a mission plan and a Flight Plan which was not just a suitable one that would accomplish a purpose, but was a suitable one to be able to fly.

EVANS The mission plan was taken care of by a lot of people. The flight planning crew insured that everything in the mission plan was taken care of. And I did not have to participate in that part of it at all.

CERNAN Procedural changes - I think in my experience on past flights, procedural changes were held to a minimum. I think they were held to a minimum because we resisted a great many of them, particularly in terms of the lunar surface activities. Procedural changes if we would have allowed them to infiltrate the system, would have been with us right up to launch date. We put a cutoff on those several weeks before launch, accepted a few of them, and then forcefully would not accept any unless absolutely mandatory after the last 3 weeks. That was the key to keeping that Flight Plan and the lunar surface procedures intact.

Mission rules and techniques - I don't think these changed from any of the previous flights.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

EVANS I don't think so either.

CERNAN They were in good shape and followed quite well. The only place we exercised a slight different approach in mission rules was the fact that we had a DOI-1 which did not take us down to the minimum altitude that we had gone to in the past and then a DOI-2 in the LM.

EVANS Let me go back to the Flight Plan here. I think this was the first time we've ever tried this from the command module standpoint anyhow. This was that each person responsible for a section of the Flight Plan, whether it was from LOI to DOI or DOI to circ, was brought down to the Cape and utilized on the simulator console while I or the backup crew ran through the preliminary Flight Plans before they were even in the print stage. We essentially were debugging their part of the Flight Plan. They could see the problems involved and we worked together to get a good plan. This took a day to a day and a half at a time. I think it was well worthwhile.

SCHMITT There were periods of some difficulty, preflight particularly, in the area of medical requirements and in some last-minute possible scientific requirements particularly on the samples, but everything seemed to get resolved satisfactorily. I can't

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

25-3

SCHMITT  
(CONT'D)

think of anything that was not handled very well by the support crew, Bob Parker in the science area, and Gordy Fullerton and Bob Overmyer in the operational areas. I guess the biggest single area that took time was the CMP's dealings with the lunar sounder. Most of our ALSEP changes were all taken care of prior to our training. We had a few minor suggestions, but they were taken care of early in the training cycle.

Mission rules and techniques were fairly well defined very early by Phil Shaffer and his crowd in the techniques area. The mission rules as defined by Jerry Griffin and his people were all in the right direction in that they enhanced the probability of making a landing in a successful mission. We really never had to exercise any of the mission rules in an abnormal way. I think that the one time that a mission rule tended to be a controlling factor was in the limitation on the work at station 4, Shorty Crater. We were up against the walkback constraint and terminated that work after only 35 minutes. Another 30 minutes there would have been extremely valuable. I hope that we got enough information on the phenomena exposed at that crater that can be understood.

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

26-1

26.0 MISSION CONTROL

CERNAN I think the GO/NO GOs and the performance of the CAPCOMs was outstanding. They gave us each GO, both CM and LM. There were no NO GOs, so we received **all** GOs. Everything was nominal. We received our updates on time. I don't think there was **any** concern or problem there. Consumables in both vehicles were nominal or better than nominal.

Oxygen - We had plenty of oxygen in both vehicles.

Electrical power - We had plenty of electrical power in both vehicles .

The RCS fuel in the service module was well above the red line for the entire first part of the mission and at or above the red line the last half of the mission. We went in on double ring in the command module and we couldn't have used very much.

EVANS I used more fuel than I would have in the simulator because there were always some rates; cross coupling in pitch and yaw in the command module RCS.

CERNAN LM RCS - We landed with more RCS than I'd ever seen in simulator, well over 80 percent, which made me feel good.

~~CONFIDENTIAL~~

**CONFIDENTIAL**CERNAN  
(CONT'D)

DPS propellant - We landed with between 7 and 9 percent, which is far more than I'd ever seen in the simulator.

SPS fuel - I think came out just about right on the money. We did not make any SPS midcourses on the way home and we had about 3 percent in each side.

The key to the Flight Plan and the key to a smooth operation of the SIM bay in lunar orbit with all three individuals in the spacecraft was the fact that real-time changes were held to a minimum. The Flight Plan was so well thought out and was working so well that real-time changes were very simple, explicit, and not time consuming.

EVANS

It was an outstanding way to run a flight. Communications were always good.

CERNAN

The only communications problem we had in the LM was right after ascent when we lost the high gain where the ground could hear everything we said. We had a lot of noise and static in the background and we could not hear anything that the ground said until about 3 minutes into the flight.

SCHMITT

Typically outstanding support. The number of extracurriculum hours the LM people and the EECOMs for the CSM in particular put in with me on Saturdays and other times just talking over systems, techniques, and mission rules were a major factor in

**CONFIDENTIAL**

~~CONFIDENTIAL~~

26-3

SCHMITT  
(CONT'D)

helping me understand and keep up to speed. The help that they gave me in designing the emergency cue cards for the LM was a major contribution although we did not use them. Had we required them I think it would have gone very well. I want to point out that Dick Thorson was instrumental in organizing the LM and joint CSM/LM sessions. He was a major organizer for the creation and the updating of the emergency cue cards.

It was *my* understanding that some of the things I had hoped could be done during the flight were not possible because of real-time discussions in the Mission Control. Specifically, one of those things was to have a summary of the thinking of the science personnel in the back room given to me while in flight. The thinking was to be based on the data that we had transmitted to them verbally and visually through the television camera. I had hoped that I would have the benefit of their thinking, but apparently this was not possible. I would like to think that in the future we can look at ways of using the team approach to science investigations in space rather than depending solely on the observational capability and the interpretative capability of the men who are performing the job. There is no reason that I can see not to use all the brain power that is available at any given task, and part of that brain power is on the ground.

~~CONFIDENTIAL~~



27.0 HUMAN FACTORS

27.1 PREFLIGHT

CERNAN Preflight health stabilization and control program - I guess it was adequate. We stayed healthy; we came back healthy. Medical care was adequate. Preflight time for rest, exercise, and sleep is something that only the crew can provide for because there's never enough time to train. When there's not enough time to train, then there's never enough time to get adequate sleep, rest, and exercise. It requires a certain amount of scheduling and crew discipline to get it all in. I believe that we got it in. Adequately prepared physiologically for the flight at lift-off.

Medical briefing and exams - After extensive preflight work for several months prior to the exams, I think that they eventually ran relatively smooth with the exception of a few misconceptions over the use of the lower body negative pressure in the CMP's G-suit garment, which eventually got resolved.

Eating habits and amount of food consumption. Preflight - I think the crew has no gripes. We were satisfied.

EVANS It was good.

**CONFIDENTIAL**

CERNAN The medical department was satisfied and we were satisfied.

SCHMITT I personally did not find any great difficulty working out or adhering to the requirements. Medical care, although a very limited requirement, was good. I had a couple of sinus infections that reacted as they always had, and we were able over a period of 10 days or two weeks to get those cleared up.

Time for exercise was probably less than it should have been, although I was able to get a good workout about every other day in addition to the workouts we got as a normal course of our EVA training. Eventually Tex started scheduling a pretty normal schedule time in the late afternoon for exercise. That helped as a reminder to see that that exercise was obtained. It is hard, at least in the lunar training program, to get in exercise periods during the day. Quite frequently, the exercise was done in the KSC gym at night. Rest and sleep is an individual thing. I made a particular effort to always get as much as I possibly could and never get behind the power curve on rest. My personal experience is that I tend to get colds and resulting sinus infections.

**CONFIDENTIAL**

~~CONFIDENTIAL~~

27-3

SCHMITT  
(CONT'D)

Medical briefing was good. The exams seemed to go very well in *my* estimation. They were as expeditious as possible under the circumstances. I think the operational medical personnel who carried out the exams are to be complimented in their efforts to see that the exam was as painless and as efficient as possible. This should also include the postflight exams on the Ticonderoga.

Eating habits and the amount of food consumption were normal except during those periods when we were on the inflight food prior to launch. Those times tended to decrease *my* appetite, although the food was certainly tolerable. It was not possible for me to eat the amount of food that was provided for me. This also applied to space work in the case of the inflight eating. Although I did not eat everything that was available in *my* food packages, I apparently needed to if I wanted to avoid losing weight. *My* appetite was down and I had a loss of weight. At the time of this recording, *my* weight has not yet gone up to preflight levels, which may have been a little high.

~~CONFIDENTIAL~~

**CONFIDENTIAL**

## 27.2 FLIGHT

CERNAN Appetite and food preference.

EVANS Appetite in-flight versus 2-week preflight - I don't think there was any change for me after the first day and a half.

CERNAN My appetite normally inflight, based upon past experience, will decrease markedly versus nominal preflight activity. Everything else being consistantly nominal, I would probably have to force myself to eat because the requirement is there to have that energy and food, but the appetite would not necessarily be there. This is just typical of me. In this particular case, the food as expected, produced a great deal of gas. For the first part of the flight, it was unpassable gas which resulted in a big football-like knot in the stomach which ranged in degree from inconvenience to annoyance to disturbing and downright painful in some cases. That also degraded the appetite because every time I ate it just stimulated this particular problem.

Difference notable in food tastes inflight versus preflight - I think the greatest difference is that there is always some gas in the water. One of the biggest problems in preflight

**CONFIDENTIAL**

CERNAN (CONT'D) is that you always have someone like Rita Rapp to prepare them and the inconvenience part of the job is done.

EVANS I didn't notice any real difference in food taste in flight versus preflight. To me, the wet packs taste like canned food, and the rehydratables had a better taste.

CERNAN It is obviously a very individualistic thing.

EVANS That's right; it's an individual thing, and I don't think it makes any difference whether from the first day on.

CERNAN Your food preference changes as to how you feel that day. If you see a package of shrimp cocktail that doesn't look very good, you don't rehydrate it; you don't want to eat it. And, as far as I'm concerned, I could eat 10 wetpacks to every rehydratable pack.

EVANS The first days when I really didn't feel like eating, I really didn't want the wetpacks. I would rather rehydrate something, because, to me, it had a better taste, because it didn't smell I guess. The smell of the wetpacks, when I really wasn't hungry, and still acclimating to zero-g flight on the first, day there, didn't appeal to me at all.

~~CONFIDENTIAL~~

CERNAN I'm going to say again that the size of food portions and meal portions is a subjective individual thing. As far as I'm concerned, the food portions are entirely too great. The entire meal portions were too great and too large. I lost my 9 pounds. I predicted I'd lose somewhere between 8 and 10 pounds, and I just don't feel like I can eat as much food as there was to eat on that flight. Even though I ate more and more as the flight progressed, I very seldom consumed the entire meal that was presented at any given time.

EVANS In my case, I think, most generally, I ate just about everything. However, if you didn't have time, which, in my case, it seemed to me like there were times when I really didn't have time - once you get all that stuff ready and it gets on through there, you really don't have time to eat everything. So you, hopefully, try to get everything made and have time to go ahead and finish everything except maybe one package.

CERNAN Food preparation and consumption - Programs with rehydration (mixing and gases) - There is gas in all the water, and there appears to be a little more in the hot than in the cold. We added more water than was called for to make up for the amount of gas in the food. When I ate the food or drank the beverages with gas in it, I could expel it through my teeth, and not

~~CONFIDENTIAL~~

CERNAN  
(CONT'D)

drink the gas, and still get the liquids out of the rehydrat-  
ables. I don't really feel I drank or ate much gas out of  
the water, by comparison to what I could if I just swallowed  
everything that was in the package.

EVANS

In *my* case, I swallowed everything. I never consciously tried  
to separate the bubbles and the water. I guess if you got an  
obvious bubble on the thing, you normally don't swallow bubbles;  
at least, I don't think I did. In the spoon-bowl packages,  
if you had a bubble in there, when you opened it up the bubble  
was gone, so there's no problem with the spoon-bowl packages.  
In spoon-bowl packages, the bubbles all developed in one big  
bubble, and you could break that one and have no problem at  
all with the gas in it. The hot water had more gas bubbles  
than the drink gun, Maybe they were smaller bubbles; let's  
put it that way.

CERNAN

Food temperature - There's no question that the hot water, and  
it was always hot, was an excellent way of preparing the  
rehydratables that are desirable hot. In the LM, you did  
not have the privilege of hot water, and the difference in  
eating LM food with cold water, after eating some of that  
nice hot-water food in the command module, was very evident.  
There are some of those wetpacks (hamburgers, beef steaks,

~~CONFIDENTIAL~~CERNAN  
(CONT'D)

what have you) that, some way of heating them up, an oven or some other way, would increase the palatability of the food immensely.

EVANS

Let me second that statement, for sure.

CERNAN

Effect of water flavor and gas content on food - I don't think the flavor was any different than what we've seen in the past. The rehydratables are very closely attuned to the taste and flavor of regular table food, but they're never quite the same.

Use of spoon-bowl packs. We used those quite frequently, and I thought, for the most part, they worked out very well. We did something different with the soups or the more liquid spoon-bowl packs. Instead of actually opening them up and eating soup with a spoon, we just cut off the end from which you rehydrate them and suck them out. The lumpy foods, like the potatoes, we of course ate with a spoon.

EVANS

Let me make one other comment about the spoon packs, the cereal portion of it. I didn't feel like I wanted to suck the cereal out through a little hole in the thing, so I always opened those up. In general, those seemed to be the ones, in order to get them properly rehydrated, you ended up with the biggest bubble in the middle of it. So every time you tried to open

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

27-9

EVANS  
(CONT'D)

one of those things, **it** was a messy operation. When you first opened **it**, **it** had a tendency to run right up the edge. If you tried to open **it** slowly, **it** would definitely run up the edge. If you tried to open **it** fast, you'd almost push **it** out.

CERNAN

The other thing about spoon-bowls - when you were finished and you put the germicidal tablet in them and you tried to seal them up, they'd have a tendency to produce waste along the sealing edge. Then you'd have to suck **it** off or wipe **it** off, or you'd have bubbles of soup or whatever was in the spoon-bowl floating around.

Opening a can - Puddings and nonliquids were fine, but when you come to the mixed fruits or the peaches, or this type of thing where you have liquid, those cans are great once you get them open. The thing about **it** is when you break the seal, you break **it** into the can, and it's not that the can is pressurized. You break **it** into the can, you reduce the amount of volume, and you force liquid out. **It** comes off the can in bubbles and you have a mess. You end up having to be very careful. If those cans would open entirely outward instead of inward, you'd reduce that mess.

EVANS

I finally got to where I could stick the can in my mouth and open the can with my teeth.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

CERNAN And he sucked the juice out as he opened it, which is a very poor way of doing it.

EVANS Poor, and kind of hard on your teeth.

CERNAN Food bar usage during EVA period - The CDR and the LMP found their use very gratifying, very easy to use. The CDR, for the most part, ate from half to three-quarters of his food bar each EVA. The LMP really hardly ate any of his at all.

Food waste stowage. Function of germicidal tablet pouch. We always had a couple of pouches around the spacecraft, stuck in corners, so that we could get to them every time we wanted to. We had the Skylab waterbags on board, and we had these small little valves in the waterbags. So I think from about the second day of the mission on, all three crewmen, (when we drank juices, regularly prepared juices), would rehydrate them with that same valve that we had on the water package. Rather than cut the other end of the juice bag off and suck the juice out through a flat plastic end, we'd use that Skylab waterbag valve, put it in the same hole which we rehydrated the juices out of, and drink it that way. We found it was less messy, easier to drink, and convenient to consume. And, I recommend that Skylab waterbag for all the juices. It's a neat little bag.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

27-11

EVANS It sure is. It's a neat bag; it's one less cut on the thing; and it's great.

CERNAN Food waste stowage - We used germicidal tablets in most all the foods. We passed up a few juices sometimes, because in drinking juices the way we just described, you had to cut off another corner of the juice bag in order to get the germicidal tablet in.

EVANS I never did put one in the juice bag.

CERNAN I put some in some of them.

Undesirable odors - I don't think there were any undesirable food odors. They were overwhelmed by the urine and feces odors and the gas odors in the spacecraft.

Quantity of food eaten on lunar surface - I think probably the appetites on the lunar surface were very good. It did not appear that the food was packaged individually for CDR and LMP, so we broke out the food for that day, laid it on the table, and had a family dinner out of what was there.

Quantity of food discarded on lunar surface prior to lift-off - I don't think we discarded any uneaten food on the lunar surface, although we did leave some uneaten food in the lunar module prior to jettison, but not very much.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

CERNAN  
(CONT'D)

Water - Chlorine taste and odor - We never had a chlorine taste in the water, and we did chlorinate every night prior to going to bed.

Iodine taste and odor - The LM water was good. We did not take a filter.

Physical discomfort of gas in water - I think the LM water had quite a bit less gas after the first cupful taken out of the LM descent water. I think we had much less gas in the LM water than in the command module.

EVANS

The only comment I want to make is that the gas/water separator that you stick on the food preparation bags always leaked like a sieve. You had to keep the cap on it at all times; otherwise, you'd end up with a big blob of water on it. The cap was quite effective, though, in stopping that blob of water from forming.

CERNAN

Intensity of thirst on mission - I think the known need for staying hydrated was there. Although I drank more and more water as the mission went on, I think that there was never really a strong intensity of thirst that plagued me, except on the lunar surface after we got back in the lunar module and I found myself drinking water continually out of the water

~~CONFIDENTIAL~~

CERNAN  
(CONT'D)      gun, prior to EVA and post-EVA. So, I think I consumed, on an average, probably twice as much water in the LM per day as I did in the command module.

EVANS          I was hustling around doing a lot more physical activity in preparation for the EVA, and at that point in time I was thirsty. I wanted to have a drink all the time. But the rest of the time I really wouldn't get that thirsty. But, you just felt like you ought to have a drink of water, and you'd drink as much as you could.

CERNAN        Work-rest sleep - Difficulty in going to sleep - I think all three crewmen experienced varying degrees of difficulty with going to sleep, and all three crewmen utilized Seconal at one time or another. The commander probably had three Seconals, and they were all taken prior to hitting the lunar surface. The CDR did not take any Seconal, to the best of his recollection, on the lunar surface or any time thereafter. I got excellent sleep when I did take a Seconal; when I did not take a Seconal, sometimes I got excellent sleep, sometimes I got marginal sleep.

EVANS          I think I probably took Seconal more than anybody up there. I'd have to look in the Flight Plan to find out for sure how many days I did not take. But I'm guessing 4 or 5 days I

~~CONFIDENTIAL~~EVANS  
(CONT'D)

probably did not take Seconal, the rest; of the time, I did. And, most of the time when I did take Seconal, I would sleep for 3 to 4 hours straight - just go to bed and go to sleep right off the bat - sleep for 3 or 4 hours and then kind of wake up, off and on, from that point on. Normally, when I'm around here, I require about 7 hours of sleep per night, and every once in a while 8, in order to feel real good. Up there, it seemed to me like I could get by quite adequately on 6 hours with no problem at all.

CERNAN

The sleep restraints were used every night in the command module by two crewmen when there were three men in there. The third man slept up in the couches. I thought they were adequate to help keep the temperature comfortable.

EVANS

When I was solo, I always slept in the sleep restraint in the capsule. The first night I put the lap belt on just to keep me from floating all over the thing. The rest of the time I didn't even bother with the lap belt; just jumped in the bag and floated wherever I happened to float around the spacecraft.

CERNAN

That's the same thing that I did when I was sleeping up in the couches with three men in the spacecraft. I just put the restraint on and floated around. It didn't bother me at all. In the LM, although my hammock was as tight as it would stretch,

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

27-15

CERNAN  
(CONT'D)

it still rested upon the suits in 1/6g, which was no problem. I thought it was extremely comfortable sleeping and, as far as I know, the LMP had no problems with the sleep restraints. A very good way to sleep in the LM, considering the tight quarters. The best thing we did was shorten that first day after launch, particularly in light of the delay, and put us on a reasonable Houston work-sleep cycle. It gave us sort of an extra day to a mission, but it put us on a very compatible work-sleep cycle, and it kept that first day to a minimum and set the rest of the days keeping pace with it. I felt very strongly that we get 8 hours of sleep period. When there were days when we were late getting to sleep about 30 or 40 minutes, I requested and got an extension of sleep period the next day. When the day had to be something very critical, like PDI day, I made sure that at all costs we did get to bed and we did get our full 8 hours of sleep. I think this probably paid off more than anything else. On the way back, after the more important aspects of the mission were complete and we got to sleep half hour or hour later, I made a decision that we'd just stick with the Flight Plan and get up on time. So it may have shortened our sleep period to 7 hours, 6-1/2 or 7-1/2 hours in some cases, but that worked out fine also. Prior to the major objectives of the mission, I felt very strongly about preserving that 8 hours, and we did.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

EVANS I was going to say I agree completely in that you need to get started as rested as you can.

CERNAN Disturbances - Typical spacecraft disturbances when one man moves or one man sneezes or when one man does something else - every man does it because you just live in that kind of an environment. The CMP is the only guy that can sleep through master alarms, crew alerts, buzzers, anything. About 3 nights out, prior to coming home, he starts talking in his sleep. He was up on the couch on duty that night, and I heard "Houston, Roger" and "Houston, this is America." Then I realized you were talking in your sleep. And then it dawned on me, supposing he decides to make an SPS burn? I stayed awake all night long listening to him.

CERNAN Exercise - I think the frequency of exercise on the way out was more consistent than on the way back. We exercised every *day* on the way out, for periods ranging from 10 minutes to 30 minutes on an individual basis. The quality of exercise I thought was pretty good. In some cases, the heart rate could be monitored on the ground; in other cases it was not. But in measuring your own heart rate on board, I think for the most part we all got up, consisting for periods of time, to 110 to 120 beats per minute. The exerciser - I think Ron and I used the exerciser for a couple of days on the way out.

~~CONFIDENTIAL~~

CERNAN  
(CONT'D)

We talked about the exerciser in the spacecraft. It was used on the way out to the Moon on just a couple of separate occasions by the CMP and the CDR and it worked adequately. I didn't find any problems with it. But I think I exercised more efficiently by sitting in the commander's couch, holding on to the arm struts very tightly, and holding myself against the LEB bulkhead and running in place to produce artificial-g. I was working my arm muscles and I was running against the bulkhead, which produced force against my legs. I could really run at different speeds and for long durations, and that's the way I did all my exercise. The LMP did his exercise that same way and he did it on the right-hand couch. I don't know how he found room to move his knees, but that's where he did it.

SCHMITT

I wasn't too concerned about my legs, so I just kind of let the legs go. I really didn't exercise the legs at all except for one time. The rest of the time I was essentially trying to exercise the arms, so I used the exerciser twice, I think, by grabbing hold with one hand and pulling it through as much as I could, back and forth, that way. Then, as Gene did, I figured out I could grab hold of the struts on the spacecraft, put my feet up in the tunnel and squeeze the struts in one way and turn the hands around and push them out. I could really work up an exercise by just kind of shaking the strut as much

~~CONFIDENTIAL~~

SCHMITT as I could. I could actually work up a sweat just doing that  
(CONT'D) type of operation.

CERNAN Muscle soreness during or after flight - There was none on anyone's part after the flight. As far as I know, certainly on my part, there was none during the flight with one exception that I'll mention. I felt (and I don't know what the metabolic assessment is from the data that came down) that when I got to the Moon there was little or no degradation in my physical capability to do the job. I felt neither short of breath nor short of muscle response or anything when I got to the surface. The only comment I want to make, and maybe it's not muscle soreness, is that after the first EVA, both the LMP's hands and my hands were extremely sore from **all** that particular type of hand-dexterity labor that's required with the ALSEP and with the drill. There were no particularly abrasive areas. The fingers and the hands were just sore from continual movement, to the extent that we both had, on both hands, several blood-blister-like formations under the fingernails. We both felt a discomfort after that first EVA. The second EVA, it was less; the third EVA, it was less; and by lift-off my hands were perfect. They did not in any way hamper anything I had to do during that first EVA. I didn't even know they were sore during the first EVA until after I got

~~CONFIDENTIAL~~

CERNAN  
(CONT'D)

out of the suit. The second EVA, they didn't hamper anything, and the third EVA, they got better still. It's like maybe having a muscle that needs work and that's what it amounted to. And the LMP's were the same way. His were bothering him the first EVA, and the second EVA they were better. It had nothing to do with the fit or size of the gloves. If I have to get a pair of gloves, I would get them fitted and sized the same way I got these fitted and sized.

EVANS

I'd like to mention one thing on muscle soreness that I heard about in preflight. I think the soreness in the back is not the lower back. It's just the muscles in the upper part of the back. I think this is from sleeping. I don't think it's from trying to hang on to something. I think it's trying to get a relaxed position in the first part of flight, because I think it's hard to pick a relaxed position with your legs. You tend to kind of hold them in one position or another. Later, on the flight, I didn't notice that at all, and I didn't really recall trying to hang on to something. The only time I can recall trying to hang on to something is during the solo orbit periods when I was trying to focus on the camera out the window. During this type of an operation, I really used my feet to hang on to things and my back wasn't sore then.

**CONFIDENTIAL**

CERNAN Perspiration during nonexercise periods - I don't think there was any on anyone's part. During exercise periods, I found myself right at the threshold of beginning to perspire, but never really felt like I was.

Inflight oral hygiene - I had no mouth discomfort. I brushed at least once a day and probably twice a day, once in the morning and once at night. I never used dental floss, and the toothbrush and toothpaste were certainly adequate.

EVANS It felt like you needed to brush your teeth every now and then. If I have to do it again, I would get my teeth cleaned prior to going on the flight. I didn't this time for some reason.

CERNAN Do you think that has anything to do with your smoking?

EVANS Maybe it did. I don't know. But it felt like I really needed to have my teeth cleaned. I felt that way before flight so the flight has nothing to do with it. Brushing frequency - Probably at least two or, most of the time, three times a day. Never did use dental floss. The toothbrush was great; I had no problems swallowing the toothpaste. Tasted pretty good as a matter of fact.

CERNAN Sunglasses or other eye protective devices - For some strange reason (I would never have believed it) but I took the sunglasses out of my pocket once, put them on for about 20 minutes, and never used them the entire flight.

**CONFIDENTIAL**